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A DISCUSSION OF THE ZYGOSITY AND ASYMMETRIES OF TWO PAIRS OF CONJOINED TWINS

by

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Although geneticists and embryologists are in general agreement that conjoined twins originate from one zygote, there still appear in scientific journals articles supporting the claim that such twins result from two zygotes which have become united during development. Jones et al. (1948) arrived at this conclusion from their study of hypertension in the pygopagus twins, Margaret and Mary. These same twins have been studied by the present writer who has evidence to show that their origin was monozygotic.

It is true that the marked dissimilarity between conjoined twins has puzzled many investigators and yet excellent theoretical explanations have been advanced to support the uniovular theory. The primary cause of monozygotic twinning, as shown by experimental studies, is a temporary suppression of development at a critical stage, followed by over-activity of development. Should the twinning process begin relatively late an incomplete separation of the inner cell mass results. In such cases the twinning process may proceed relatively slowly in some one region of the twinning axis. For example, the legs may develop more slowly than the arms, with resulting asymmetries.

A clearer understanding of the intra-pair differences in conjoined twins may result from some long-term surveys now in progress. The present writer through a study of birth membranes, foetal circulations, dermal configurations and other physical characters is investigating the association of *dissimilarity* between monozygotic twin pairs and their *twinning-time*. The twinning-time is measured as follows:

1) Twinning of the embryonic cell mass occurring early before chorionic tissue has been established; each twin forming his own chorion (2 placentae or 1 dichorionic placenta).

2) Twinning occurring after the embryonic cell mass is surrounded by the chorion; a single chorion results, but with separate foetal circulations (monochorionic, separate foetal circulations).

3) Twinning occurring after both the chorion and foetal circulation are developed; a single chorion and a common foetal circulation resulting (monochorionic, common foetal circulation).

Ricevuto il 23. XII. 1951

4) Twinning of the embryonic cell mass delayed until both chorion and amnion have been formed; the twins (either separate or conjoined) lying within a common amniotic sac (monochorionic, monoamniotic and a common foetal circulation).

The assumption to be tested is that the later the time of twinning, the less

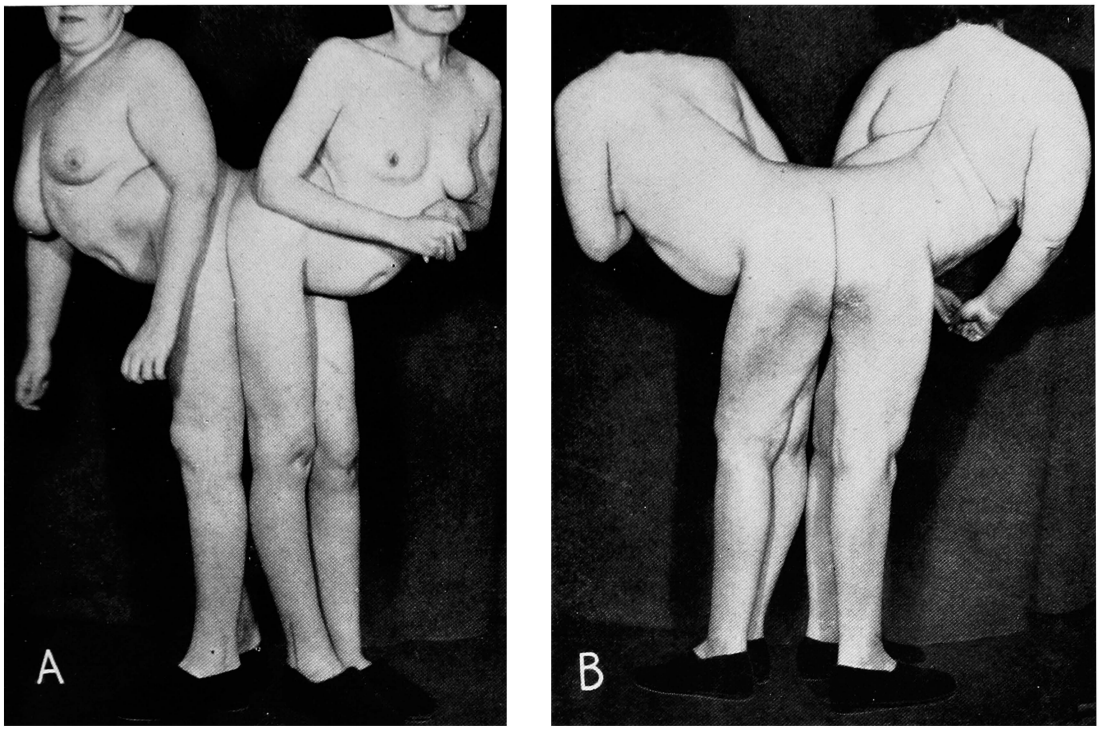

Fig. 1. A, anterior view of the pygopagus twins, with Mary on the left of the photograph and Margaret on the right. B, posterior view. (After Jones et al.)

alike the twins are in appearance, since differentations are rapidly established.

Dissimilarities of the two pairs of conjoined twins here described will be concerned mainly with their dermal configurations.

Dermal Configurations

Dermal configurations have proved to be particularly useful in studies of bilaterality. These skin patterns, although inherited, are also subject to modification as the result of disturbance of foetal growth occurring at the third and fourth months of development. The configurations are formed at the sites of foetal mounds situated on the tips of the digits, in the four interdigital areas and in the

thenar and hypothenar areas of both hand and foot, as well as in the calcar area of the sole. During the third and fourth months of foetal development the mounds are receding at the same time as the skin ridges are being laid down. The interplay of the timing of the two processes gives rise to complex patterns, which

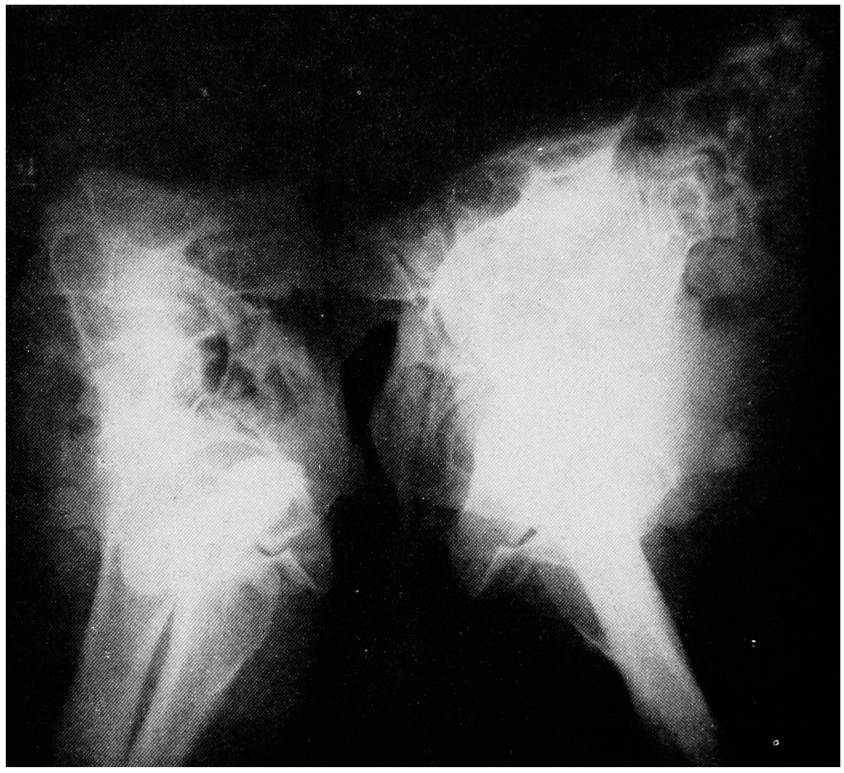

Fig. 2. Roentgenograms of the twins' juncture (Mary on the right and Margaret on the left). (After Jones et al.).

once established, remain unchanged from then on throughout life except for increase in the size of the skin ridges (Cummins and Midlo, 1943).

Dermal Prints of Margaret and Mary

Dermal prints of the conjoined twins, Margaret and Mary, were made during their engagement at the Canadian National Exhibition in Toronto, Canada, in September 1938 when the women were 26 years of age. Special attention was given at that time to their palmar and plantar configurations since their finger-

prints had already been described by Cummins and Mairs (1934). Sketches of their palm and sole patterns were published by Wilder (1916) but these are incomplete and in part inaccurate.

These pygopagus twins joined side-to-side (Fig. 1) were born in Holyoke, Mass., U.S.A., on May 20, 1912. Anatomically Margaret is the left of the pair, Mary the right. Physical examinations reveal that associated with the union of the sacrum there is a single anus and a common rectum for a length of 3 inches. The vaginal openings are barely separated by a thin septum. The medial labia are absent and the lateral ones are fused. The spinal canals communicate. In standing Margaret's trunk is inclined to the left, Mary's to the right (Jones et al., 1948). The writer is much indebted to Dr. Stewart Jones of the Lahey Clinic, Boston, who kindly loaned the photographs, roentgenogram and drawing reproduced in Figures 1, 2 and 3.

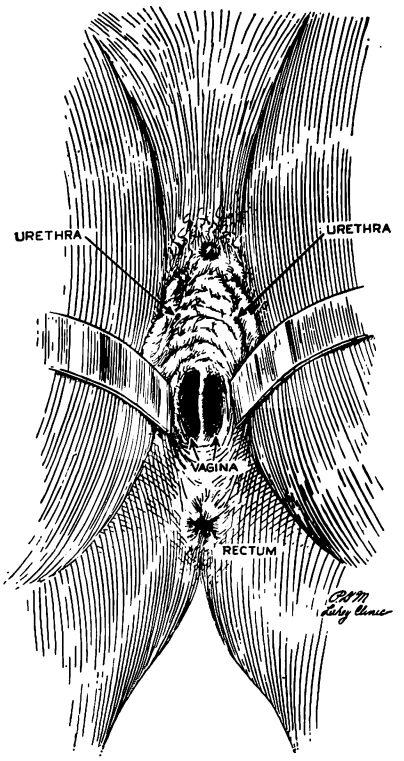

Fig. 3. Surface relations of the perineum of Margaret and Mary. (After Jones et al.).

Digital Patterns

The digital patterns with their ridge counts are summarized in Table 1 and their homolateral differences in Table 3. Compared homolaterally four fingers out of ten show different patterns, giving a 40 % difference. The digital ridge counts show close agreement for both the total and homolateral counts (153-155, 78-79, 75-76), with a homolateral difference of only 1.6 % (based on a standard total ridge count of 125).

Palmar Configuration

Prof. H. H. Wilder examined the palms of the twins when they were 2 years old. He was unable to take prints but he made a sketch of the pattern for all four hands. However both his sketch and description are in error in recording the hypothenar configurations as a loop ulnar instead of a loop radial (Wilder 1916).

The palmar patterns traced from the prints, are outlined in Figure 4 and formulated in Table 2. Marked similarities in all four palms are readily seen, particularly in the presence on each hand of a loop pattern (L) in the fourth interdigital area and of a loop radial pattern (L^r) in each hypothenar area. Homolateral differences between the main lines and axial triradii amount to 12.8; while between the palmar patterns there is no difference (0.0). Average differences for both

https://doi.org/10.1017/S112096230004258X Published online by Cambridge University Press

digital and palmar configurations amount to 15.9 for monozygotic and 34.0 for dizygotic twins (Table 3). The average difference for Margaret and Mary is 13.6, being thus in close agreement with that of one-egg twins. If Margaret and Mary had been born completely separated, and their zygosity analysed by this method, the conclusion would have been reached that they were the product of one fertilized ovum.

Table 1. Digital Patterns and Ridge Counts of the Conjoined Twins, Margaret and Mary (Data from Cummins and Mairs 1934)

Name	Left Fingers	Ridge Counts	Right Fingers
	5 4 3 2 1	L R	1 2 3 4 5
Margaret	U U U R W	Total	W R U W U
	0-17 0-20 0-15 5-0 16-22	79 76	19-4 0-2 14-0 20-10 21-0
		155	
Mary	U W U W U		W U U W U
	0-15 12-19 0-15 11-5 0-18	78 75	21-19 9-0 12-0 17-11 16-0
		153	

Symbols: U, loop ulnar; R, loop radial; W, whorl.

Table 2. Palmar Formulae of the Conjoined Twins, Margaret and Mary

Name	*Linear Formula* D . C . B . A	Axial Triradii	*Pattern Formula* Hypo. T/I_1. I_2. I_3. I_4.
	Left Palms		
Margaret	7 . 5″ . 5″ . 1	t (10.9)	L^r. O. O. O. L.
Mary	7(8) . 5″(6) . 5″ . 3(3h)	t (9.2)	L^r. O. O. O. L.
	Right Palms		
Margaret	7(8) . 5″(6) . 5″ . 3h	t (13.0)	L^r. O. O. O. L.
Mary	8 . 6 . 5″ . 3	t (8.0)	L^r. O. O. O. L.

Symbols: L, loop; L^r, loop radial; O, open field; 3h, main line terminating in area 3 within hypothenar configuration; Hypo., hypothenar; T/I_1, thenar and first interdigital; I_2, second interdigital; etc.

Plantar Patterns

Wilder in 1914 took ink prints of the feet of the twins, but since the children were only 2 years old at the time, the prints were poor. From photographs of these prints sketches were made, which are essentially correct, although the hypothenar configurations are omitted from all four soles and on Margaret's left sole

the fourth interdigital pattern (loop distal) and basal fusion of digits II and III are not shown (Wilder, 1916).

Plantar configurations of Margaret and Mary are outlined in Figure 4 and formulated in Table 4. A comparison of the outlines shows the similarity 1) of Margaret's left sole and Mary's right, each with patterns in the third and fourth interdigital areas; 2) of the two median feet of the twins (Margaret's right and Mary's left) each with a loop distal pattern under the fused second and third toes.

Table 3. Homolateral Differences in the Digital Patterns and Ridge Counts, Main Lines and Palmar Patterns of the Conjoined Twins, Mary and Margaret

Compared Sets	Digital Patterns	Ridge Counts	Main Lines & Axial Triradii	Palmar Patterns	Average
Mary & Margaret	40.0	1.6	12.8	0.0	13.6
Monozygotic Twins (53 pairs Walker, 1951)	23.0±1.4	10.9±1.0	17.6±1.4	21.4±1.8	15.9±0.9
Dizygotic Twins (20 pairs Walker, 1951)	47.0±4.4	32.5±4.5	31.5±2.2	23.0±8.9	34.0±2.2

Table 4. Plantar Formulae of the Conjoined Twins, Margaret and Mary

Name	*Linear Formula* D . C . B . A . Hal . - . Hypo. Cal.	*Pattern Formula* Then (1). Then (2)/I_1. I_2. I_3. I_4.
	Left Soles	
Margaret	15 . 10 . 8 . 0 . 7 . . L^t . 0 . 0 .	O/A^f . O . L^d . $L^d y$.
Mary	15 . 15 . 11 . 0 . 9 . . L^t . 0 . 0 .	O/A^f . L^d . O . O .
	Right Soles	
Margaret	15 . 14 . 13 . 0 . 8 . - . L^t . 0 . 0 .	O/A^f . L^d . O . O .
Mary	13 . 13 . 9 . 0 . 5 . . L^t . 0 . 0 .	$O/L^d y$. O . W . $L^d y$.

Symbols: L^t, loop tibial; L^d, loop distal; A^f, arch fibular; W, whorl; y, proximal triradius; underline bar (_____) indicates fusion of digits.

In conjoined twins of the pygopagus type, the division of the posterior part of the body, including the legs has been so delayed that a single median limb bud probably gave rise to the adjacent legs. Stillborn pygopagus twins frequently possess a common median limb which has failed to divide completely. In such cases of delayed twinning the symmetry of the two joined median feet is obvi-

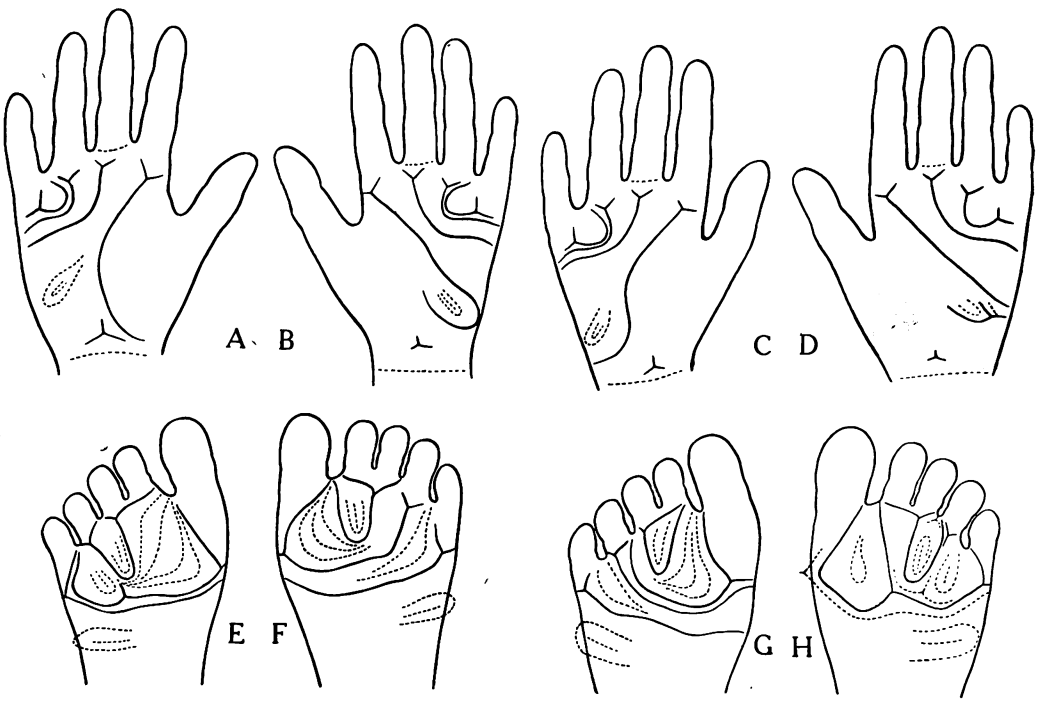

Fig. 4. Outlines of palmar and plantar configurations of the conjoined twins, Margaret and Mary. A, left palm of Margaret; B, right palm of Margaret; C, left palm of Mary; D, right palm of Mary; E, left sole of Margaret; F, right sole of Margaret; G, left sole of Mary; H, right sole of Mary.

Table 5. Homolateral and Heterolateral Differences in the Plantar Configurations of the Conjoined Twins, Margaret and Mary.

Compared Sets	Main Lines	Plantar Patterns	Average
Margaret and Mary	*Homolateral Differences* 45.0	85.0	65.0
	Heterolateral Differences 30.0	25.0	27.5
Monozygotic Twins 51 pairs Walker, 1951	*Homolateral Differences* 32.1±2.7	32.7±2.2	32.1±2.1
	Heterolateral Differences 39.3±3.5	37.2±2.5	38.1±2.6

ously heterolateral, not homolateral. In pygopagus twins there may therefore be homolateral symmetry in the arms, but heterolateral symmetry in the legs, because of the lag in the twinning process of the inferior limbs. Cummins and Mairs (1934) have pointed out that similarly in " twinned digits " where the supernumerary digit is completely developed and separate, patterns of similar configuration occur in the majority of instances.

Homolateral differences for the plantar configurations of Margaret and Mary amount to 65.0; heterolateral to 27.5. Clearly the symmetry in this case is heterolateral. Details of these calculations are given in Table 5, as well as averages for monozygotic twins.

Physical Characters

Some physical characters which have not been previously recorded for Margaret and Mary are their dark blue eye color, dark brown hair color and clear creamy skin color. For each of these traits the twins show concordance. Both women are right-handed.

Blood Grouping

The much debated question concerning the zygosity of conjoined twins could possibly be settled very simply and finally if the complete blood groupings for all known blood systems were determined for a conjoined pair. Complete concordance would be expected for monozygosity, discordance for dizygosity.[1] We were most anxious to obtain this information for Margaret and Mary and in December 1951 every effort was made to do so, but we were unable to obtain per mission to take blood samples. However, since an intercommunication of the twins' vascular systems has been demonstrated by Jones et al. (1948) it is highly improbable that differences in the blood grouping exist.

It may also be pointed out that physiologically it is inconceivable how the bodies of dizygotic twins could remain united, since it is impossible to graft together foreign tissues, with the exception of the non-vascular cornea.

Placenta

Highly significant evidence in favor of a monozygotic origin for the conjoined twins, Margaret and Mary, is contained in the description of their placenta given by Wilder (1916, page 218) as follows: " As I was fortunate enough to be on the spot at the time of the birth, I secured the afterbirth, which had been preserved with great care by the attending physicians. There was a single chorion, without trace of a separating partition, and the placenta was bilobed, and nearly as large as two normal placentae. The umbilical cord was a single one for 11 cm. from the placenta, and proceeded from the margin, at the point of bilobing, that is, at the notch between the two halves.

" This common cord contained the usual two arteries and a single median

[1] Unless a genetic mosaic or chimera were established (Owen, Davis & Morgan, 1946).

vein, and at the forking of the cord to supply the two umbilici the vein split into two branches, so that one of the arteries and one branch of the vein continued into each individual cord. The cord supplying Margaret, now and always the heavier infant, was 11 cm. long from the fork to the ligature; that supplying Mary was 6. Margaret's cord was also somewhat greater in caliber. Assuming that the ligatures were made in both cases at about the same point these latter figure have a meaning, otherwise they are of little value ".

We have thus evidence that the conjoined twins, Margaret and Mary, were monozygotic, monochorionic and monoamniotic with a common umbilical cord.

Lucio and Simplicio Godino [2]

The conjoined twins, Lucio and Simplicio Godino, were born March 2, 1908, at Sulaton on the Island of Samar in the Philippines. When 22 months old they were taken to the United States and Europe to be exhibited, accompanied by their mother. Eight years later, following a legal controversy between their manager and the Brooklyn Society for the Prevention of Cruelty to Children, they were adopted by the Hon. Teodoro R. Yangco, Commissioner to the United States from the Philippines. As wards of the State they were educated, graduated from the University of the Philippines and became chartered accountants. At 21 years of age they married sisters, Natividad and Victorina Matos, former classmates in High School.

In September 1936 the writer took palm and sole prints of the twins during their engagement at the Canadian National Exhibition in Toronto. These prints, we believe, are the only ones ever taken, aside from finger prints.

In the autumn of the same year Lucio contracted lobar pneumonia and died 10 days later on November 24, 1936, in the York Hospital, New York City. Simplicio was then surgically separated from his brother, but later he developed cerebro-spinal meningitis and died December 5, 1936. They were 28 years of age.

Anatomically the union of the Godino men was somewhat similar to that of Margaret and Mary, namely a pygopagus side-to-side union. Anatomically Simplicio was the right twin, Lucio the left. During the legal controversy in 1918 extensive physical examinations of the pair were made. It was shown by Plaggemeyer and Selby (1920) that (1) there was no bony union between any portion of the twins; and (2) that the last part of the rectum was common to the pair; Lucio presenting a functioning anus, Simplicio an imperforate rectum. The coccyx of Lucio was well developed as compared with that of Simplicio which was rudimentary in type. Both boys belonged to blood group A.

The Godino boys exhibited a remarkable freedom of movement and mutual co-ordination as shown in their dancing, skating and tennis playing.

[2] I wish to express my thanks to the Hon. Teodoro Yangco for placing at my disposal certain records concerning the Godino twins, including the photograph here reproduced. I am indebted also to Prof. Harold Cummins who kindly loaned me papers from the Wilder Collection referring to these twins.

Fig. 5. Photograph of the conjoined twins, Simplicio and Lucio Godino on the tennis court. Lucio about to serve with tennis racket.

https://doi.org/10.1017/S112096230004258X Published online by Cambridge University Press

Handedness of the Godino Twins

Errors regarding the handedness of the Godino twins have crept into the published records, owing to the fact that a description such as " the left twin " has two meanings. It may mean the left twin as one faces the conjoined pair, or it may mean anatomically the left member of the conjoined pair. The guardian of

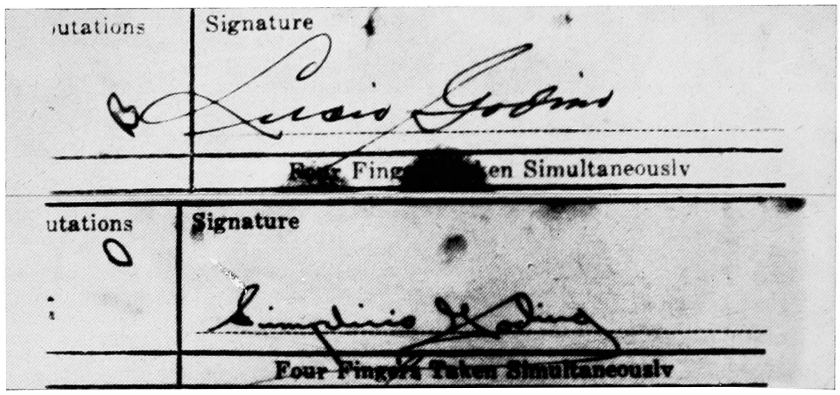

Fig. 6. Signatures of Lucio and Simplicio Godino, recorded on their personal identification cards, May 12, 1936.

the Godino twins (T. R. Yangco) reassured me that " Lucio was right-handed, Simplicio left-handed ". The right-handedness of Lucio can be seen in their photograph (Fig. 5) where he holds the tennis-racket ready to serve. Their handedness is also reflected in their signatures in the effortless writing of right-handed Lucio compared with the cramped back-hand style of left-handed Simplicio (Fig. 6).

Sullivan (1919) states that the left twin was right-handed and the right twin left-handed, but he has their names interchanged.

Confusion is found also in some of the early photographs of the twins, where the names are interchanged or the photograph is printed in reverse.

Digital and Palmar Configuration

At the time the Godino twins were palm and sole printed, they suggested that use might be made of their fingerprints on file for personal identification in the United States. We are indebted, therefore to J. Edgar Hoover, Federal Bureau of Investigation, Washington, D. C., who after their deaths arranged to have copies of these prints placed at our disposal for study. They afforded us considerable assistance in completing the readings of the digital ridge counts.

As in the case of Margaret and Mary, the homolateral differences for digital and palmar configurations of the Godino twins are slight (Fig. 7 and Tables 6, 7

and 8). Only one pair of fingers differ in pattern (10%) and the total and homolateral ridge counts are similar (226-225, 110-105, 116-120) giving a homolateral difference of 7.2%. The palmar main lines and axial triradii show a difference of 32.2 and the palmar patterns of 30.0. The average difference amounts to 19.9,

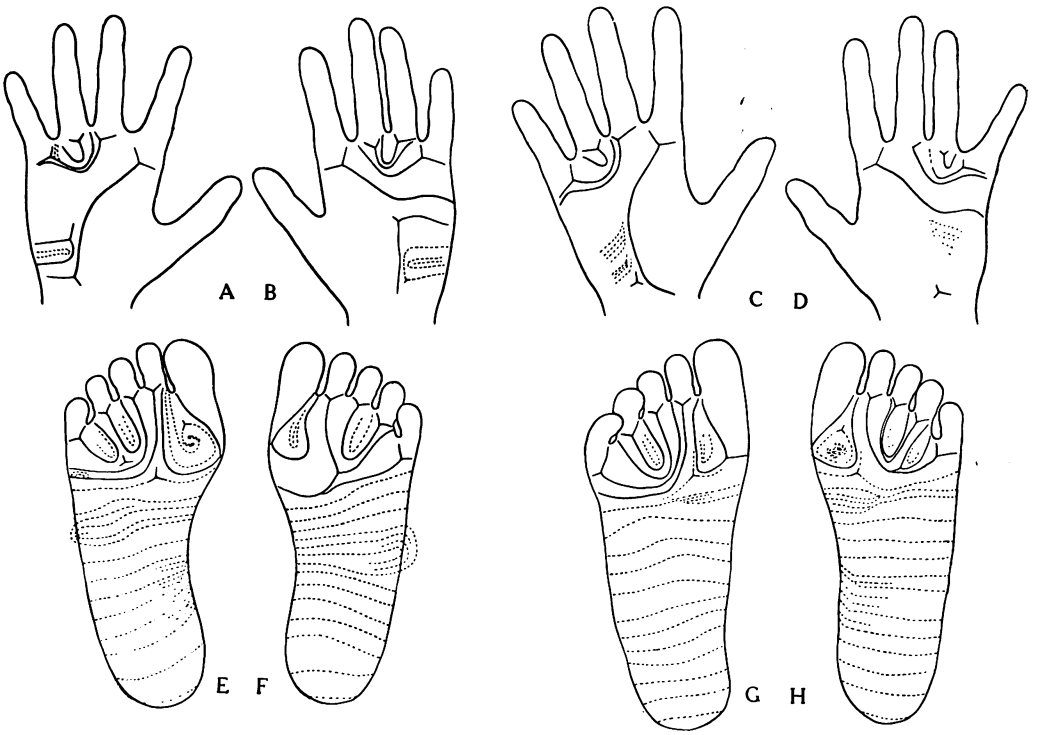

Fig. 7. Outlines of the palmar and plantar configurations of the conjoined twins, Lucio and Simplicio Godino. A, left palm of Lucio; B, right palm of Lucio; C, left palm of Simplicio; D, right palm of Simplicio; E, left sole of Lucio; F, right sole of Lucio; G, left sole of Simplicio; H, right sole of Simplicio.

being thus in close agreement with that of monozygotic twins (15.9) and deviating widely from the value for dizygotic pairs (34.0).

According to Newman (1931, b) main-line palmar formulae with high numbers tend to occur on right hands, those with lower numbers on left hands. Newman proposed the thesis that in conjoined twins the separation takes place relatively so late, that the right and left half embryos have become more or less irreversibly fixed. The right half embryo will tend to express its characters in a right-handed way, the other in a left-handed way. Newman also points out that in all cases of conjoined twins where the palmar formulae are given " the two hands of the

right twin show decidedly more right-handed formulae than the two hands of the left twin. ... Had the right twin components not shown a more right-hand expression of dermatoglyphics, the principal thesis (referred to above, Newman 1931, a) would have been badly shaken ".

Table 6. Digital Patterns and Ridge Counts of the Conjoined Twins, Lucio and Simplicio Godino

Name	Left Fingers					Ridge Counts		Right Fingers				
	5	4	3	2	1	L	R	1	2	3	4	5
						Total						
	U	W	W	W	W			W	W	W	W	U
Lucio	0-17	14-21	19-25	21-18	26-24	110	116	21-25	16-20	23-25	24-19	22-0
						226						
	U	W	W	W	W			W	W	W	W	W
Simplicio	0-18	20-18	14-19	22-20	17-26	105	120	29-19	12-21	22-24	26-19	20-12
						225						

Symbols: U, loop ulnar; W, whorl.

Table 7. Palmar Formulæ of the Conjoined Twins, Lucio and Simplicio Godino

Name	*Linear Formula* D . C . B . A	Axial Triradii	*Pattern Formula* Hypo . T/I_1. I_2. I_3. I_4.
	Left Palms		
Lucio	9(10) . 7 . 5″(6) . 2	t(10.8)t′(33.3)t″(43.1)	V/L^u . O. O. O. L/V.
Simplicio	9 . 7 . 5″ . 1	t (7.5)	$A^u(VL^u)$. O. O. O. L.
	Right Palms		
Lucio	11 . 9 . 7 . 5′	t(12.5)t″(48.1)	L^u . O. O. L. O.
Simplicio	9 . 7 . 5″ . 5′	t (10.2)	$A^u(VL^u)$. O. O. O. L.

Symbols: A^u, arch ulnar; L^u, loop ulnar; V, vestigial; for other symbols see Table 2.

The palmar formulae (as well as the handedness) of the Godino twins offer just such contradictory evidence. The left twin is right-handed and has " right-handed formulae ", while the right twin is left-handed with corresponding formulae (as defined by Newman). Also in the case of Margaret and Mary no such palmar main line differences are found and both girls are right-handed. Moreover Margaret and Mary are the product of a very late twinning as shown by the presence of a single branched umbilical cord and yet no mirror-imaging in handedness has resulted. Newman's theory of irreversible fixation due to late origin is therefore not upheld by the present evidence.

Table 8. Homolateral Differences in the Digital Patterns and Ridge Counts, Main Lines and Palmar Patterns of the Conjoined Twins, Lucio and Simplicio Godino

Sets Compared	Digital Patterns	Ridge Counts	Main Lines & Axial Triradii	Palmar Patterns	Average
Lucio & Simplicio	10.0	7.2	32.2	30.0	19.9
Monozygotic Twins (53 pairs Walker, 1951)	23.0±1.4	10.9±1.0	17.6±1.4	21.4±1.8	15.9±0.9
Dizygotic Twins (20 pairs Walker, 1951)	47.0±4.4	32.5±4.5	31.5±2.2	23.0±8.9	34.0±2.2

Plantar Configurations

A comparison of the plantar configurations of the Godino twins (Fig. 7 and Tables 9 and 10) shows a heterolateral symmetry. The two median feet are alike in their hallucal patterns (loop distal) and in the occurrence of third interdigital patterns. The lateral feet (the left of Lucio and right of Simplicio) have whorl patterns in the hallucal area and third and fourth interdigital configurations. Scores for homolateral and heterolateral differences amount to 46.5 and 29.0. Clearly the symmetry is heterolateral.

Table 9. Plantar Formulæ of the Conjoined Twins, Lucio and Simplicio Godino

Name	*Linear Formula* D . C . B . A . Hal	*Pattern Formula* . Hypo. Cal. Then (1). Then (2)/I_1. I_2. I_3. I_4.
	Left Soles	
Lucio	7 . 9 . 5 . 5 . 13	w/L^t. O . V . O_y/W . O . L^d. $L^d y$.
Simplicio	11 . 9 . 7 . 5 . 13	O . O . O . O/L^d . O . L^d. O .
	Right Soles	
Lucio	15 . 10 . 8 . 7 . 13	L^t . O . O . O/L^d . O . L^d. O .
Simplicio	12 . 11(10) . 9(8) . 7/6 . 13	L^t . O . V . O/W_y . O . L^d. $L^d y$.

Symbols: as in Table 4.

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Table 10. Homolateral and Heterolateral Differences in the Plantar Configurations of the Conjoined Twins, Lucio and Simplicio Godino

Sets Compared	Main Lines	Plantar Patterns	Average
Lucio and Simplicio	*Homolateral Differences* 22.9	70.0	46.5
	Heterolateral Differences 47.9	10.0	29.0
Monozygotic Twins 51 pairs Walker, 1951	*Homolateral Differences* 32.1±2.7	32.7±2.2	32.1±2.1
	Heterolateral Differences 39.3±3.5	37.2±2.5	38.1±2.6

Comments

Previous studies of monstrosities have revealed the fact that monozygotic twinning may take place along one of several axes. An excellent review of such studies is given by Gedda (1951). Well-formed twins, still joined at birth, supply important data regarding the symmetry of growth patterns and such data are valuable in attempting to recognize and interpret the symmetries found in completely separated monozygotic twins. Viable conjoined twins offer many advantages over the non-viable pairs, especially when the physiological functions of the conjoined bodies are known and when functions such as handedness have become established. As was pointed out earlier in this paper Newman's theory of mirror-imaging of handedness in conjoined twins is not supported by our data.

The association in conjoined twins of homolateral symmetry of the palmar configurations and heterolateral symmetry of the plantar patterns is consistent with the accepted theories of the development of dermal configurations, which are the resultant of both hereditary and environmental factors acting before the fifth foetal month. Dermal configurations serve therefore as important records of disturbed foetal growth occurring during their formation, namely the third and fourth foetal months.

Summary

1. The dermal configurations of two pairs of conjoined twins are described, Margaret and Mary G., and Lucio and Simplicio Godino.

2. A homolateral symmetry of the palmar patterns, but a heterolateral symmetry of the plantar patterns is found for each pair of twins.

3. The average homolateral palmar difference (13.6 and 19.9) is in close agree-

ment with that of monozygotic twins (15.9) and much lower than that for dizygotic twins (34.0). Hence the dermatoglyphic evidence is that each set of conjoined twins is derived from one zygote.

4. The plantar configurations have been modified by developmental factors due to the lag in the twinning process of the inferior limbs and the resulting symmetry is heterolateral.

5. For Margaret and Mary G. the average homolateral plantar difference is 65.0, the heterolateral 27.5. For Lucio and Simplicio Godino the homolateral is 46.5, the heterolateral 29.0. The heterolateral symmetry is clearly demonstrated.

6. Additional evidence of the monozygotic origin of Margaret and Mary is the fact that their placenta was monochorionic, monoamniotic, with a single branching umbilical cord.

7. The handedness and dermal configurations of both pairs of conjoined twins offer contradictory evidence of Newman's theory of mirror-imaging in twins.

8. The theoretical impossibility of conjoined twins having a dizygotic origin is pointed out, since this would involve the grafting together of foreign tissues and a common circulation for different blood groups.

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RIASSUNTO

1. Vengono descritte le configurazioni del derma di due coppie di gemelli congiunti, Margaret e Mary G. e Lucio e Simplicio Godino.

2. Viene riscontrata in ciascuna coppia di gemelli simmetria omolaterale delle impronte palmari e simmetria eterolaterale delle impronte plantari.

3. La media delle differenze palmari omolaterali (13,6 e 19,9) è in accordo con quella dei gemelli MZ (15,9) e molto bassa rispetto a quella dei gemelli DZ (34.0). Pertanto il reperto depone nel senso che ciascuna coppia di gemelli congiunti deriva da un solo zigote.

4. Le configurazioni plantari furono modificate da fattori dello sviluppo relativi al ritardo nel processo di gemellazione degli arti inferiori e la simmetria risultante è eterolaterale.

5. In Margaret e Mary G. la differenza media plantare omolaterale corrisponde a 65.0, la eterolaterale a 27.5. In Lucio e Simplicio Godino l'omolaterale corrisponde a 46.5, la eterolaterale a 29.0. La simmetria eterolaterale viene così chiaramente dimostrata.

6. Una prova aggiuntiva dell'origine monozigotica di Margaret e Mary consiste nel fatto che la loro placenta era monocoriale, monoamniotica con un solo cordone ombelicale ramificantesi.

7. La manualità e le configurazioni del derma di entrambe le coppie di gemelli congiunti depone in senso contrario alla teoria di Newman sulle forme speculari dei gemelli.

8. L'impossibilità teorica che i gemelli congiunti abbiano un'origine dizigotica è resa più evidente dalla considerazione che essa potrebbe significare innesto reciproco di tessuti estranei e circolazione in comune di differenti gruppi sanguigni.

RÉSUMÉ

1. On décrit les configurations du derme de deux paires de jumeaux réunis, Margaret et Mary G., Lucio et Simplicio Godino.

2. On constate dans chaque paire de jumeaux une symmétrie homolatérale des empreintes palmaires et une symmétrie hétérolatérale des empreintes plantaires.

3. La moyenne des différences palmaires homolatérales (13,6 et 19,9) est conformé à celle des jumeaux MZ (15,9) et très basse par rapport à celle des jumeaux DZ (34.0). Pourtant le tableau témoigne dans le sens que chaque couple de jumeaux conjoints dérive d'une seule origine zygotique.

4. Les configurations plantaires ont été modifiées par des facteurs du développement relatifs au retard dans le processus de gémellation des membres inférieurs, et la symmétrie qui en résulte est hétérolatérale.

5. Chez Margaret et Mary G. la différence moyenne plantaire homolatérale correspond à 65.0, et la moyenne hétérolatérale à 27.5. Chez Lucio et Simplicio Godino l'homolatérale correspond à 46.5, l'hétérolatérale à 29.0. La symmétrie hétérolatérale est ainsi clairement démontrée.

6. Une preuve supplémentaire de l'origine monozygotique de Margaret et Mary consiste dans le fait que leur placenta était monocoriale, monoamniotique avec un seul cordon ombilical qui s'était ramifié.

7. La manualité et les configurations du derme des deux couples de jumeaux conjoints témoigne en sens contraire à la théorie de Newman sur les formes spéculaires des jumeaux.

8. L'impossibilité théorique que les jumeaux conjoints aient une origine dizygotique est rendue plus évidente par la considération qu'elle pourrait signifier la greffe réciproque de tissus étrangers ainsi que circulation en commun de différents groupes sanguins.

ZUSAMMENFASSUNG

1. Beschreibung der Hautgestaltung zweier verbundener Zwillingspaare: Margaret und Mary G. und Lucio und Simplicio Godino.

2. In jedem Zwillingspaare wird homolaterale Symmetrie in den Handflächen und heterolaterale Symmetrie der Fussohlen festgestellt.

3. Der Durchschnitt der homolateralen Handflächen-Differenzen (13,6 und 19,9) stimmt mit dem der MZ Zwillinge (15,9) überein und ist sehr niedrig im Vergleich mit dem der DZ Zwillinge (34,0). Der Befund lässt also darauf schliessen, dass jedes verbundene Zwillingspaar von einem einzigen Zygoten herkommt.

4. Die Gestaltungen der Fussohlen erlitten Veränderungen durch Entwicklungsfaktoren, in Verband mit der verspäteten Zwillingsbildung der unteren Gliedmassen; und die daraus gebildete Symmetrie ist heterolateral.

5. Bei Margaret und Mary G. ist die mittlere homolaterale Fussohlen-Differenz gleich 65.9, die heterolaterale gleich 27.5. Bei Lucio und Simplicio Godino ist die homolaterale gleich 46.3, die heterolaterale gleich 29.0. Die heterolaterale Symmetrie ist damit klar erwiesen.

6. Ein ergänzender Beweis des monozygotischen Ursprungs der Margaret und Mary liegt in der Tatsache, dass ihre Placenta monocorial, monoamniotisch war, mit einer einzigen, sich verzweigenden Nabelschnur.

7. Die Handbeschaffenheit und die Gestaltung der Haut beider verbundener Zwillingspaare spricht gegen die Theorie Newmann's von der spekularen Form der Zwillinge.

8. Die theoretische Unmöglichkeit des dizygotischen Ursprunges der verbundenen Zwillinge wird noch augenscheinlicher durch die Erwägung, dass sie vechselseitige Aufpfropfung fremdartiger Gewebe und gemeinsames Zirkulieren veschiedener Blutgruppen bedeuten könnte.